

CLAIMS:

1. A bi-directional cable communication system configured to communicate information via a cable network, the cable communication system incorporating diagnostic and calibration logic, the cable communication system comprising:

5 a first transceiver, coupled at a selected point of distribution of the cable network, that transmits a downstream test signal having predetermined characteristics on the cable network in a selected downstream channel at a predetermined power level, that receives corresponding downstream diagnostic information in a selected upstream channel, the downstream diagnostic information including a downstream power loss metric, and that calibrates downstream transmission power based on the downstream power loss;

10 a second transceiver, coupled to the cable network at a selected downstream location, that receives the downstream test signal in the selected downstream channel, that compares the received signal with the predetermined characteristics and power level to determine the downstream diagnostic information including a downstream power loss metric and a downstream noise level metric for the selected downstream channel, and that transmits the downstream diagnostic information in a selected upstream channel;

15 the second transceiver transmitting an upstream test signal with predetermined characteristics on the cable network in the selected upstream channel at a predetermined power level, that receives corresponding upstream power information in the downstream channel, and that calibrates upstream transmission power based on the upstream power information; and

20 the first transceiver receiving the upstream test signal, comparing the received upstream test signal with the predetermined characteristics and power level to determine corresponding upstream diagnostic information including an upstream power loss metric and an upstream noise level metric in the upstream channel, determining the upstream power information based on the upstream power loss metric, and transmitting the power information in the selected downstream channel.

25 2. The cable communication system of claim 1, wherein the first transceiver further comprises diagnostic logic that determines if downstream communication using a selected downstream modulation scheme is realizable based on the downstream noise level

and that determines if upstream communication using a selected upstream modulation scheme is realizable based on the upstream noise level.

3. The cable communication system of claim 2, wherein the downstream and upstream noise level metrics each comprise a signal to noise ratio.

5 4. The cable communication system of claim 2, wherein the upstream and downstream modulation schemes are based on quadrature-amplitude modulation (QAM).

5. The cable communication system of claim 4, wherein the selected downstream modulation scheme is QAM-256 and wherein the selected upstream modulation scheme is QAM-16.

10 6. The cable communication system of claim 1, wherein the first transceiver calibrates an attenuation factor for the selected upstream channel.

7. The cable communication system of claim 1, wherein the predetermined characteristics for both the downstream and upstream test signals include frequency, timing and amplitude information.

15 8. The cable communication system of claim 1, wherein the downstream test signal is a tone based on a selected constellation point of a QAM-256 constellation and wherein the upstream test signal is a tone based on a selected constellation point of a QAM-16 constellation.

20 9. The cable communication system of claim 1, wherein the first transceiver determines upstream spectrum information from the upstream test signal, and includes diagnostic logic that performs a frequency transform of the upstream spectrum information to determine upstream frequency characteristics.

25 10. The cable communication system of claim 9, wherein the diagnostic logic performs a Fast-Fourier Transform (FFT) of the upstream spectrum information to determine the frequency characteristics of the upstream communication bandwidth.

11. A communication system configured to communicate across a cable system having a point of distribution and at least one downstream subscriber cable link, the communication system configured to operate in a diagnostic and calibration mode, the communication system comprising:

5 a switch router, coupled to the cable system at the point of distribution, that transmits a predetermined downstream test signal at a predetermined power level using a selected downstream channel, that receives corresponding downstream channel diagnostic information including downstream channel power loss, that calibrates transmission power for the downstream channel based on the downstream channel power loss, that receives an upstream  
10 test signal and determines corresponding upstream channel power loss and noise level, and that transmits corresponding upstream channel power information on the selected downstream channel; and

at least one gateway, each gateway coupled to a corresponding downstream subscriber cable link, each gateway transmitting a predetermined upstream test signal at a predetermined  
15 power level in a selected upstream channel, that receives corresponding upstream channel power information, that calibrates transmission power of the selected upstream channel based on the upstream channel power information, that receives a downstream test signal and determines downstream channel diagnostic information including downstream channel power loss and noise level, and that transmits the downstream channel diagnostic information in the  
20 selected upstream channel.

12. The communication system of claim 11, wherein the at least one gateway comprises a plurality of gateways, each gateway coupled to corresponding downstream subscriber cable links, and wherein the switch router and the plurality of gateways collectively operate in the diagnostic and calibration mode to calibrate a corresponding pair of  
25 downstream and upstream channels for each gateway.

13. The communication system of claim 11, wherein the switch router determines if downstream communication is realizable using the selected downstream modulation scheme for the selected downstream channel and wherein the switch router determines if upstream communication is realizable using the selected upstream modulation scheme for the  
30 selected upstream channel.

14. The communication system of claim 11, wherein the switch router comprises:

a switch router controller that operates the switch router in diagnostic mode;

a downstream modulator, coupled to the switch router controller, that operates according to a selected downstream modulation scheme for providing IF modulation information, and that generates the predetermined downstream test signal as a tone based on a predetermined constellation point;

a radio frequency (RF) downstream transmitter, coupled to the downstream modulator and the switch router controller, that converts the IF modulation information into a corresponding RF signal and that transmits the RF signal in a downstream channel and at a power level selected by the switch router controller;

an RF upstream receiver, coupled to the switch router controller, that tunes to a selected upstream channel to convert received upstream RF signals into an IF signals; and

an upstream demodulator, coupled to the RF upstream receiver and the switch router controller, that operates according to a selected upstream modulation scheme, that controls receiver gain and provides a gain level indicative thereof, and that determines the upstream channel power loss and noise level based on the received upstream test signal;

wherein the switch router controller determines upstream power information and transmits via the downstream modulator the upstream power information in the selected downstream channel.

15. The communication system of claim 14, wherein the selected downstream modulation scheme is QAM-256 and wherein the selected upstream modulation scheme is QAM-16.

16. The communication system of claim 14, wherein the switch router further comprises:

the upstream demodulator further determining upstream spectrum information using the received upstream test signal; and

the switch router controller including a processor that performs a frequency transform on the upstream spectrum information.

17. The communication system of claim 11, wherein each gateway comprises:

a tuner that tunes to a selected downstream channel to receive and convert RF signals into a corresponding IF signals;

a receiver gain control circuit, coupled to the tuner, that controls gain of received IF signals and that generates a gain level value indicative thereof;

a downstream demodulator, coupled to the receiver gain control circuit, that operates according to the selected downstream modulation scheme to demodulate IF signals, the downstream demodulator comparing a downstream test signal with a predetermined downstream modulation constellation point to determine an error value;

a gateway controller, coupled to the downstream demodulator, that determines downstream channel diagnostic information including downstream power loss and noise level of a selected downstream channel based on the gain level value and the error value, that forwards the downstream channel diagnostic information for upstream transmission, and that programs a gain control value to calibrate upstream power level based on received upstream power information;

an upstream modulator, coupled to the gateway controller, that operates according to the selected upstream modulation scheme and that generates an RF upstream test signal based on a predetermined upstream modulation constellation point, that converts the downstream channel diagnostic information into an RF diagnostic signal and that transmits the RF diagnostic signal in the selected upstream channel; and

a programmable gain device, coupled to the upstream modulator and the controller, that amplifies signals transmitted by the upstream modulator according to the programmed gain control value.

18. The communication system of claim 17, wherein the selected downstream modulation scheme is QAM-256 and wherein the selected upstream modulation scheme is QAM-16.

19. A method of characterizing a cable network and calibrating a bi-directional cable communication system, comprising:

transmitting a downstream test signal from a point of distribution on the cable network in a selected downstream channel at a predetermined downstream power level, the downstream test signal having predetermined characteristics;

receiving the downstream test signal in the selected downstream channel at a downstream location;

determining a downstream power loss metric of the downstream channel by comparing a power level of the received downstream test signal with the predetermined downstream power level;

transmitting downstream diagnostic information including the downstream power loss and downstream noise level metrics in a selected upstream channel;

calibrating downstream transmit power at the point of distribution based on the downstream power loss metric;

transmitting an upstream test signal from the downstream location on the cable network in a selected upstream channel at a second predetermined power level, the upstream test signal having second predetermined characteristics;

receiving the upstream test signal in the selected upstream channel at the point of distribution;

determining an upstream power loss metric of the upstream channel by comparing a power level of the received upstream test signal with the predetermined upstream power level;

transmitting upstream power information in the selected downstream channel; and

calibrating upstream transmit power at the downstream location based on the upstream power information.

20. The method of claim 19, further comprising:

determining a downstream noise level metric of the downstream channel by comparing the predetermined characteristics of the downstream test signal with corresponding characteristics of the received downstream test signal;

determining, based on the downstream noise level metric, if downstream communication is realizable using a selected downstream modulation scheme on the selected downstream channel;

determining an upstream noise level metric of the upstream channel by comparing the second predetermined characteristics with corresponding characteristics of the received upstream test signal; and

determining, based on the upstream noise level metric, if upstream communication is realizable using a selected upstream modulation scheme on the selected upstream channel.

21. The method of claim 19, further comprising:

generating a test tone based on the selected downstream modulation scheme to develop the downstream test signal; and

generating a test tone based on the selected upstream modulation scheme to develop the upstream test signal.

22. The method of claim 21, wherein said generating a test tone comprises selecting a constellation point of a selected modulation scheme, the selected constellation point having known amplitude, frequency and timing information.

23. The method of claim 19, wherein said determining downstream and upstream power loss metrics each comprise:

performing gain control relative to a target power level and generating a gain error level; and

comparing the generated gain error level with a corresponding predetermined power level.

24. The method of claim 19, wherein said determining downstream and upstream noise level metrics each comprise:

comparing frequency, timing and amplitude information between a received test signal and predetermined frequency, timing and amplitude information and generating an error value.

25. The method of claim 19, wherein said determining if downstream or upstream communication is realizable each comprises:

comparing a determined noise level metric with a predetermined threshold signal to noise ratio.

26. The method of claim 19, wherein said calibrating upstream transmit power at the downstream location comprises programming a gain level value that controls a programmable gain amplifier.

27. The method of claim 19, further comprising:  
determining an upstream spectrum using the received upstream test signal; and  
performing a frequency transform function on the upstream spectrum.

28. The method of claim 27, wherein the frequency transform function provides frequency spectrum information for the upstream frequency bandwidth.